ACTIVE MATRIX ORGANIC LIGHT EMITTING DIODE (AMOLED) DISPLAY PANEL AND A DRIVING CIRCUIT THEREOF

BACKGROUND OF THE INVENTION

[0001] (1) Field of the Invention

[0002] This invention relates to an active matrix organic light emitting diode (AMOLED) display panel and a driving circuit thereof, and more particularly to a current-driven AMOLED display panel and a driving circuit thereof.

[0003] (2) Description of the Related Art

[0004] With the progress in the fabrication technology of organic light emitting diodes (OELDs), an OLED display with a plurality of OLEDs arranged in matrix for illumination has become a popular choice among all the flat panel displays. Based on the difference in driving methods, the OLED displays in present can be sorted into simple matrix system type and active matrix system type, and the latter is a better choice for large size displays and high resolution usage.

[0005] **FIG. 1** shows an equivalent circuit diagram of a pixel driving unit in a traditional voltage-driven active matrix organic light emitting diode (AMOLED) display. The pixel driving unit includes an OLED, a transistor T1, a transistor T2, and a capacitor C. A source electrode of the transistor T1 is connected to a data line (not shown in this figure) for receiving a driving voltage signal Vdata. A gate electrode of the transistor T1 is connected to a scan line (not shown in this figure) for receiving a scanning voltage signal Scan. A source electrode of the transistor T2 is connected to an anode of the OLED. A drain electrode of the transistor T2 is provided with a potential Vdd. A gate electrode of the transistor T2 is connected to a drain electrode of the transistor T1. A cathode of the OLED is provided with another potential Vss. Two opposing ends of the capacitor C are connected to the gate electrode of the transistor T2 and provided with the potential Vdd respectively.

[0006] As the scanning voltage signal Scan is at a high level state for switching on the transistor T1, the driving voltage signal Vdata on the data line is applied to the gate electrode of the transistor T2 and also the capacitor C. As the scanning voltage level Scan is at a low level state for switching off the transistor T1, the capacitor C is floated to store a potential Vcs identical to a difference between the voltage levels of Vdata and Vdd. In this situation, it is understood that the gate to source voltage Vgs of the transistor T2 equals to a difference between the voltage levels of Vdd and Vdata. A difference between the gate to source voltage Vgs and the threshold voltage Vt of the transistor T2 further determines the current I passing through the OLED for illuminating.

[0007] **FIG. 2** shows an equivalent circuit diagram of a pixel driving unit in a traditional current-driven AMOLED display. As shown, the pixel driving unit includes an OLED, a transistor T1, a transistor T2, a transistor T3, a transistor T4, and a capacitor C. A source electrode of the transistor T1 is connected to a data line (not shown in this figure) for receiving a driving current signal Idata. A gate electrode of the transistor T1 is connected to a scan line (not shown in this figure) for receiving a scanning voltage signal Scan. A drain electrode of the transistor T1 is connected to a source electrode of the transistor T2. A gate electrode of the transistor T2 is connected to a gate electrode of the transistor T4. A drain electrode of the transistor T2 is connected to an anode of the OLED and also a source electrode of the transistor T4. A source electrode of the transistor T3 is connected to the data line for receiving the driving current signal Idata. A gate electrode of the transistor T3 is connected to the scan line for receiving the scanning voltage signal Scan. A drain electrode of the transistor T3 is connected to the gate electrode of the transistor T2 and also the gate electrode of the transistor T4. A source electrode of the transistor T4 is connected to the anode of the OLED. A drain electrode of the transistor T4 is provided with a potential Vdd. The cathode of the OLED is provided with another potential Vss. Two opposing ends of the capacitor C are connected to the gate electrode of the transistor T4 and the anode of the OLED respectively.

[0008] As the scanning voltage signal Scan is at a high level state for switching on the transistors T1 and T3, the driving current signal Idata is applied to the transistor T2 and the capacitor C and generates a corresponding potential Vcs stored in the capacitor C. It is noted that as the scanning voltage from the scan line is at a low level state for switching off the transistors T1 and T3, two corresponding mirror circuits with respect to the capacitor C and the OLED are created. The transistors T2 and T4 are located in the two corresponding mirror circuits respectively. As the two transistors T2 and T4 are set with identical electronic properties, the potential Vcs stored in the capacitor C may generate a current I identical to the driving current signal Idata in value passing through the transistor T4 and determine the illumination of the OLED.

[0009] In the voltage-driven pixel driving unit shown in **FIG. 1**, the value of the threshold voltage Vt of the transistor T2 may be significantly increased due to the accumulation of charges inside the transistor T2 during operation. Since the value of current passing through the OLED is very much influenced by the value of threshold voltage Vt in the transistor T2. A decreasing of current passing through the OLED and a worse brightness is unpreventable.

[0010] In the current-driven pixel driving unit shown in **FIG. 2**, the value of current passing through the OLED is determined by the driving current signal Idata and is irrelevant to the variation of the threshold voltages of the transistors T2 and T4 so as to prevent a decreasing of current passing through the OLED. However, since the current-driven pixel driving unit needs four transistors T1, T2, T3, and T4 to show the above mentioned characteristic, an increasing in fabrication cost and a worse transparency is unpreventable.

[0011] Accordingly, how to prevent the increasing of threshold voltage of the transistors in the traditional voltage-driven pixel driving unit to maintain the brightness of OLEDs, and how to reduce the number of the required electronic elements, such as transistors, in the tradition current-driven pixel driving unit to improve the transparency, are two important issues for the development of OLED display industry.

SUMMARY OF THE INVENTION

[0012] It is a main object of the present invention to improve the transparency of the pixel driving unit in the